(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 281 273 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication of patent specification: **21.07.93**

(51) Int. Cl.5: **D21H 23/06**, //D21H11/04, D21H17/65

(21) Application number: **88301311.2**

(22) Date of filing: **17.02.88**

# (54) Cellulosic pulp.

(30) Priority: **27.02.87 US 19831**
**04.02.88 US 146751**

(43) Date of publication of application:
**07.09.88 Bulletin 88/36**

(45) Publication of the grant of the patent:
**21.07.93 Bulletin 93/29**

(84) Designated Contracting States:
**AT BE CH DE ES FR GB IT LI NL SE**

(56) References cited:
**DE-C- 235 821**
**US-A- 1 993 265**
**US-A- 2 114 809**
**US-A- 3 112 242**

(73) Proprietor: **The BOC Group, Inc.**
**85 Chestnut Ridge Road**
**Montvale, New Jersey 07645(US)**

(72) Inventor: **Hollerbach, George H., Jr.**
**201 Central Avenue**
**Cranford New Jersey 07016(US)**
Inventor: **Kleinberg, Walter**
**47 Brookside Road**
**Edison New Jersey 08817(US)**

(74) Representative: **Wickham, Michael et al**
**c/o Patent and Trademark Department The BOC Group plc Chertsey Road**
**Windlesham Surrey GU20 6HJ (GB)**

**EP 0 281 273 B1**

## Description

This invention relates to the preparation of cellulosic pulps, and more particularly to the chemical treatment of alkaline cellulosic pulp prior to processing in a paper making assembly.

At the present time the digestion of cellulosic materials is primarily carried out utilising either soda, sulphate, sulphite or neutral sulphite processes and is sometimes performed by batch methods, i.e., particulate cellulosic materials in relatively small pieces or chips and delignifying chemicals in aqueous solution are introduced into a pressure cooker or digester wherein the mixture is raised to delignifying temperatures and thereafter discharged as concentrated pulp and spent liquor for further processing operations. Continuous methods are also known. Processing data for determining delignifying conditions, such as strength of the chemicals, time and temperature, are determined to a great extent from actual experience rather than from correlated laboratory data, since the severity of the chemical attack on the charged cellulosic materials varies considerably even within wood species.

The delignified cellulosic material from the digester is introduced into a blow tank for dilution with diluting liquors to a pumpable consistency of from 1.5 to 4 percent solids for the separation and recovery of the cooking chemicals and prior to refining and further treatment of the cellulosic pulp slurry for introduction to a paper making machine, such as a Fourdrinier machine.

To impart appropriate and/or desired physical properties to the paper, paper board or the like to be formed in such machine, diverse chemicals are added to the cellulosic pulp slurry to improve one or more properties which would be otherwise lacking. For example, sizing agents are employed to make papers resistant to penetration of certain liquids; clays and other pigments to improve brightness, opacity, and printing properties; starches and gums to improve fibre bonding and fibre distribution; various synthetic polymers to impart wet strength; dyes and coloured pigments to give desired colour; surface active agents to improve absorbency, combat self-sizing, and decrease foam and pitch troubles.

Generally, cellulosic pulp slurries are advantageously processed with such additives at a pH of from about 4.5 to 7.0. Cellulosic pulps produced by alkaline pulping techniques are at a pH of from about 12.0 to 10.0 and require extensive chemical treatment, e.g., a first treatment with sulphuric acid, to bring the resulting cellulosic pulp into the appropriate pH range of from 9.5 to 7.5 for effective treatment with such hereinbefore described additives.

US-A-2 114 809 relates to the production of sized paper from a pulp stock which may be of the sulphite, soda or kraft kind. The pulp has added to it a carbonate filler such as chalk and a sizing agent such as alum. Reaction takes place in solution between the alum and the chalk to form carbon dioxide. This reaction and subsequent processing steps take place in closed vessels so as to ensure that some of the carbon dioxide dissolves by virtue of a partial pressure of carbon dioxide in the ullage spaces of the vessels. A sufficient quantity of carbon dioxide may also be introduced into the vessels from some outside source.

The presence of dissolved carbon dioxide helps to create favourable acid conditions at the stage at which the final pulp is converted into paper. No means however is disclosed for controlling the pH of the pulp.

There is thus a need for an improved process and apparatus for adjusting the pH of alkaline cellulose pulp prior to forming paper therefrom, and the invention aims at meeting this need.

According to the present invention there is provided a process for manufacturing paper from alkaline cellulosic pulp produced by the delignification of cellulosic material wherein thus produced alkaline delignified cellulosic pulp is fibrilated in a refiner to form paper-forming pulp, and introducing gaseous carbon dioxide into said delignified pulp, characterised in that said gaseous carbon dioxide is introduced upstream of the fibrilation step in an amount to form a precursor paper-forming pulp stream having a pH of from 8.5 to 6.5, and the introduction of carbon dioxide is regulated in response to measurements of the pH of the precursor paper-forming pulp stream.

The invention also provides an apparatus for manufacturing paper wherein delignified cellulosic pulp is fibrilated in a refiner to form paper-making pulp, including means for injecting and dispersing gaseous carbon dioxide into a delignified cellulosic pulp stream, characterised in that said means is located upstream of said refiner so as to enable carbon dioxide to be injected in an amount to form a precursor paper-forming pulp stream having a pH of from 8.5 to 6.5 and the apparatus further includes means for sensing the pH of said paper-forming pulp stream and regulating the introduction of carbon dioxide in response to the sensed pH so as to maintain a desired pH.

The pH said pH is regulated to be in the range of from 6.5 to 8.5 since a pH of greater than about 8.5 provides minimal benefits and a pH of less than about 6.5 requires excessive carbon dioxide. A pH in the range 8.5 to 7.5 is preferred. Preferably, gaseous carbon dioxide is also introduced into the refined pulp under conditions to adjust and maintain at from about 7.0 to 5.5 the pH of the pulp

stream prior to introduction into a paper making assembly. A pH in the range of 6.0 to 5.5 is more preferred.

The invention makes possible the manufacture of paper of improved physical properties. The invention also makes possible better pulp drainage thereby permitting paper forming with reduced energy requirements, for drying. Other advantages that may be derived from the use of the invention include improved operation of the paper making machine, a reduction an rejected paper, and reduced requirements for certain chemical additives (e.g. alum or aluminium sulphate).

The present invention will now be described by way of example with reference to the accompanying drawing of a schematic flow diagram of a paper making apparatus.

Referring now to the drawings, there is schematically illustrated a paper making machine, such as a Fourdrinier machine, generally indicated as 10 and including a headbox 12 for distributing paper-forming pulp stock onto the moving screen 36 of the Fourdrinier machine 10. Cellulosic pulp material produced by standard alkaline pulping techniques are introduced into a blow tank (not shown), washed and stored in a chest 14 and combined with white water in line 16 to a pumpable consistency of about 1.5 to 5.0 percent, generally about 4 percent solids, and passed in line 18 to the suction side of a pump 20.

A pulp slurry in line 22 from the discharge side of the pump 20 is contacted with gaseous carbon dioxide from line 21 by an injection assembly 25 to form a combined stream in line 26. Gaseous carbon dioxide is added in an amount sufficient to provide a pH of from about 8.5 to about 6.5, in the combined pulp stream which is passed through a refiner 28 to fibrilate the cellulosic pulp material.

In a preferred embodiment, the line 30 downstream from the refiner 28 contains a second injecting assembly 60 for contacting the refined pulp stream with additional gaseous carbon dioxide from line 21. Gaseous carbon dioxide is added in an amount sufficient to provide a combined stream in downstream line 62 having a pH in the range from about 7.0 to 5.5.

The pulp from line 62 is mixed with white water in line 46 to a solids consistency of about 0.4 percent and passed through pump 32 and line 34 to a headbox 12. Generally, a sizing precursor, such as alum, is added to the pulp by an alum introduction means 48. The alum may be introduced as a liquid into line 30, line 46 or directly into the headbox 12 (as shown). The pulp in headbox 12 is distributed onto the endless woven-wire belt 36 of the Fourdrinier machine 10. During passage over the endless woven-wire belt 36, a liquid (hereinabove referred to as "white water") is drained from the cellulosic pulp sheet being formed, and the pulp sheet is dried and passed to further processing steps in the formation of finished paper, generally in the form of a roll.

The white water 40 drained from the cellulosic pulp-during distribution on the endless woven-wire belt 36 is collected in a sump 38 of the Fourdrinier machine 10 and is passed to a mixing tank 42, called a wire pit, to which are added by line 44 other additive chemicals as required for manufacturing a specific paper product. A purge stream of the white water is generally continually withdrawn through line 45 to maintain chemicals, such as sulphate ions, at certain predetermined levels in the recycling white water stream in line 46.

Typically, the gaseous carbon dioxide in line 21 is at a pressure of about 377 kPa to 1380 kPa (about 40 to 200 psig), and is preferably at a pressure of from 69 to 138 kPa (10 to 20 psi) greater than the pressure of the cellulosic pulp in line 22. The gaseous carbon dioxide injection assembly 25 is a porous metal sparger, preferably, in combination with a static mixer which provides good gas dispersion and maximum transfer efficiency. Suitable spargers and static mixers are commercially available from a number of manufacturers. Proper addition of the gaseous carbon dioxide permits rapid and intimate mixing in the cellulosic pulp such that a uniform, predetermined resulting pH level is readily attained in line 26 at a point downstream of the discharge side of the pump 20 and prior to introduction into a subsequent unit operation, e.g., the refiner 28. The pH of the treated pulp slurry is measured with a meter assembly 50 having a pH probe 52 in line 26. Preferably a meter output is used to generate a feedback control signal to operate a valve 56 in line 21 to regulate the flow of carbon dioxide in line 24 to achieve the desired pH level in the pulp stream. Line 24 also contains a check valve 27.

The second gaseous carbon dioxide injecting assembly 60 is a porous metal sparger; adequate mixing may be obtained without a second static mixer. A second meter assembly 64 having a pH probe 66 in line 62 measures the pH and provides a control signal to operate a second valve 68 connected in line 70 between carbon dioxide line 21 and the second injecting assembly 60. Line 70 also contains a check valve 72. The pressure of carbon dioxide in line 21 is preferably at a pressure of from about 170 to 24 kPa (about 10 to 20 psig) greater than the pressure of the refined pulp stream in line 30.

## EXAMPLES

The following examples are illustrative of conditions for the process of the present invention, and

it is to be understood that the scope of the invention is not to be limited thereby.

Example I

In a plant producing 6.3 kg/s (600 tons per day) of paper, a concentrated pulp stream of a pH of 11.0 and a density of 15 percent solids produced by kraft processing of soft wood, is diluted with white water to a consistency of 4 to 5 percent solids and a resulting pH of 10.5. The diluted pulp stream is introduced into and passed (with trim dilution, as required) to the suction side of a pulp pump 20 at a rate of 132 litres per second (2100 GPM (gallons per minute)). To the dilute pulp stream in the downstream conduit from the pulp pump, there is added gaseous carbon dioxide at a rate of 3.4 kg (7.5 pounds) per minute to form a dilute pulp stream having a pH of 7.0 when introduced into a refiner 28 for processing. No carbon dioxide is added to the refined pulp stream.

Alum is added to the refined pulp stream at a rate of 0.79 kg per second (10.4 pounds per minute). The thus treated refined pulp stream is thereupon further diluted with white water to a solids content of 0.4 percent and a pH of about 4.5 before introduction into the headbox 12 of the Fourdrinier machine 10 for processing into paper.

The controlled introduction of carbon dioxide before the refining step results in stronger paper as a result of improved refining when compared to the introduction of sulphuric acid to adjust pH prior to the refining step.

Example II

In a plant producing 15.75 kg per second (1500 tons per day) of paper board, dilute pulp streams of a solids content of about 4 to 5 percent solids are produced by kraft pulp processing from hard and soft woods. A dilute soft wood pulp stream and a dilute hard wood pulp are combined to form a primary line pulp stream to be refined to form the dilute pulp stream to be diluted by white water to a solids content of about 0.4 percent for introduction into the primary headbox of the paper machine.

The dilute soft wood pulp stream having a solids content of 4 to 5 percent and a pH of 10.5 is passed (including trim white water) to the suction side of a pulp pump at a rate of 189 litres per second (3000 GPM). To the dilute pulp stream (solids content 4 percent) in the downstream conduit from the pulp pump, there is added 4.71 kg (10.4 pounds) per minute of gaseous carbon dioxide. The resulting pulp stream at a pH of 7.0 is introduced into a primary refiner prior to being combined in a secondary refiner with a dilute hard wood pulp stream pH of 7.0.

The dilute hard wood pulp stream having a solids content of 4 to 5 percent and a pH of 10.5 is passed (including trim white water) to the suction side of a pulp pump at a rate of 57 litres per second (900 GPM). To the dilute hard wood pulp (solids content 4 percent) in the downstream conduit from such pulp pump, there is added 0.24 kg per second (3.1 pounds per minute) of gaseous carbon dioxide to form the dilute hard wood pulp stream at a pH of 7.0 introduced into the secondary refiner. From the secondary refiner the combined pulp stream is further diluted with white water (recovered from the wire pit of the paper machine and acidified with sulphuric acid) to a solids content of 0.4 percent and a pH of about 4.5 before introduction into a primary headbox. To the primary headbox, there is added 1.03 kg of alumn per second (13.5 pounds of alum per minute).

The top sheet for the paper board is produced from a dilute soft wood pulp stream of a solids content of 4 to 5 percent which is introduced (together with trim white water) into the suction side of a pulp pump at a rate of 40 litres per second (650 GPM) to form a dilute pulp stream having a solids content of 4 percent in the discharge conduit therefrom. To this dilute pulp stream there is added 0.2 kg per second (2.6 pounds per minute) of gaseous carbon dioxide to form a dilute pulp stream of pH 7.0 which is successively passed through a primary and a secondary refiner. The thus refined pulp stream (pH 7.0) is withdrawn from the secondary refiner and mixed with white water (recovered from the wire pit of the paper machine and acidified with sulphuric acid) for dilution to a further diluted pulp stream of a solids content of 0.4 percent and a pH of about 4.5 before introduction into the primary headbox together with alum at the rate of 0.95 kg (2.1 pounds) per minute.

The controlled introduction of gaseous carbon dioxide instead of sulphuric acid prior to the refining steps eliminates certain dilution handling tanks and corrosive liquid piping. Additionally, the physical properties of the resulting paper product are significantly improved because the easily regulated quantity and the self-buffering capabilities of gaseous carbon dioxide substantially eliminate pulp pH variations which can decrease paper strength.

Example III

In a plant producing 14.7 kg per second (1400 tons per day) of paper, a concentrated pulp stream of pH of 11.0 and a density of 15 percent solids produced by kraft processing of soft wood and hard wood, is diluted to a consistency of 4 to 5 percent solids and a resulting pH of 10.5. The diluted pulp stream is introduced into and passed

(with trim dilution, as required) to the suction side of a pulp pump 20 at a rate of 126 litres per second (2000 GPM). To the dilute pulp stream in the downstream pipe 26 from the pulp pump, there is added gaseous carbon dioxide at a rate of 0.25 kg per second (3.3 pounds per minute) to form a dilute pulp stream having a pH of 8.0 when introduced into a refiner 28 for processing.

Additional gaseous carbon dioxide is added at a rate of 0.11 kg per second (1.4 pounds per minute) to the refined pulp in line 30 downstream from the refiner to form a combined stream in pipe 62 having a pH of 5.5.

Alum is added to the refined pulp stream at a rate of 0.51 kg per second (6.7 pounds per minute). The thus treated refined pulp stream is thereupon further diluted with white water to a solids content of 0.4 percent and a pH of about 5.0 before introduction into the headbox 12 of the Fourdrinier machine 10 for processing into paper. No sulphuric acid is used.

In accordance with the process of the present invention, chemical cost savings are realised through elimination of about ten kg per metric ton (about twenty pounds per ton) of sulphuric acid resulting from the use of gaseous carbon dioxide to effect reduction of the pH of the raw and refined pulp. Further cost savings are sometimes possible because of the cost differential between carbon dioxide and sulphuric acid. Additionally, a reduction in rejected paper is realised by the process of the present invention.

In the preferred process, the use of sulphuric acid is eliminated, and the amounts of gaseous carbon dioxide introduced into the raw and refined pulp stream are individually selected to obtain optimum operation of the refiner 28 and the paper making machine 10. In order to optimise the refining process, the pH of the pulp stream in line 26 before the refiner is preferably in the range from about 8.5 to about 7.5. The pH of the white water 40 in the wire pit 42 of a paper making assembly is usually in the range 7.0 to 4.5, typically between 5.5 and 4.5, For this reason, the pH of the pulp stream in line 62 following the refiner is preferably in the range from about 6.0 to about 5.5. The use of carbon dioxide to lower the pH of a combined stream to a value less than about 5.5 is usually uneconomical because increasing amounts of carbon dioxide are required.

Displacing sulphuric acid produces a paper sheet having a higher brightness. Still further, improved operation of the Fourdrinier machine is realised with improved effectiveness since pulp handling is effected in the absence of sulphuric acid and its corrosive effects.

The use of gaseous carbon dioxide significantly reduces the build up of barium sulphate (barium is present in the cellulosic raw material) and concomitant scaling of the paper making assembly therewith, thereby reducing the frequency of "boil-out" protocols which temporarily shut down the paper-making line.

The use of gaseous carbon dioxide in processing of recycled paper products has significantly improved the operation of the paper machines and associated equipment.

## Claims

1. A process for manufacturing paper from alkaline cellulosic pulp produced by the delignification of cellulosic material wherein thus produced alkaline delignified cellulosic pulp is fibrilated in a refiner to form paper-forming pulp, and introducing gaseous carbon dioxide into said delignified pulp, characterised in that said gaseous carbon dioxide is introduced upstream of the fibrilation step in an amount to form a precursor paper-forming pulp stream having a pH of from 8.5 to 6.5, and the introduction of carbon dioxide is regulated in response to measurements of the pH of the precursor paper-forming pulp stream.

2. A process according to Claim 1, wherein carbon dioxide is added in an amount to adjust the pH of said precursor paper-forming pulp stream to a value in the range from 8.5 to 7.5.

3. A process according to Claim 1 or Claim 2, wherein a liquid stream obtained from a paper making operation is mixed with said delignified cellulosic pulp to form said paper-forming pulp to be contacted with said gaseous carbon dioxide.

4. A process according to Claim 3, wherein said liquid stream is mixed with said delignified cellulosic pulp and is introduced into a suction side of a pulp pump and wherein gaseous carbon dioxide is introduced into said paper forming pulp discharged from said pulp pump.

5. A process according to any one of the preceding claims, further characterised in that there is introduced into the fibrilated pulp gaseous carbon dioxide in an amount to form a precursor paper forming pulp stream having a pH of from 7.0 to 5.5.

6. A process according to Claim 5, wherein the gaseous carbon dioxide is added to the fibrilated pulp in an amount to adjust the pH of said precursor paper forming pulp stream to a value in the range from 6.0 to 5.5.

7. A process according to any one of the preceding claims, further comprising mixing a liquid stream obtained from a paper making operation with the stream of fibrilated pulp after it has been contacted with gaseous carbon dioxide.

8. A process according to any one of the preceding claims, in which no sulphuric acid is added to the alkaline cellulosic pulp.

9. An apparatus for manufacturing paper wherein delignified cellulosic pulp is fibrilated in a refiner (28) to form paper-making pulp, including means (25) for injecting and dispersing gaseous carbon dioxide into a delignified cellulosic pulp stream, characterised in that said means is located upstream of said refiner (28) so as to enable carbon dioxide to be injected in an amount to form a precursor paper-forming pulp stream having a pH of from 8.5 to 6.5 and the apparatus further includes means (52, 50, 56) for sensing the pH of said paper-forming pulp stream and regulating the introduction of carbon dioxide in response to the sensed pH so as to maintain a desired pH.

10. Apparatus according to claim 9, further including means (60) for injecting and dispersing gaseous carbon dioxide into a fibrilated cellulosic pulp stream in an amount to form a precursor paper-forming pulp stream having a pH of from 7.0 to 5.5 downstream from the refiner (28).

11. Apparatus according to claim 10, further including means (66, 64, 68) for sensing the pH of said precursor paper-forming pulp stream downstream of the refiner (28) and for regulating the introduction of carbon dioxide in response so as to maintain a desired pH downstream of the refiner (28).

## Patentansprüche

1. Verfahren zur Herstellung von Papier aus alkalischer Zellulosepulpe, hergestellt durch Ligninentfernung aus zelluloseartigem Material, wobei die so hergestellte, alkalische, von Lignin befreite Zellulosepulpe in einem Refiner unter Bildung von papierbildender Pulpe zerfasert wird, und gasförmiges Kohlendioxid in diese von Lignin befreite Pulpe eingeführt wird, dadurch gekennzeichnet, daß dieses gasförmige Kohlendioxid strömungsaufwärts von der Zerfaserungsstufe in einer Menge, um einen Vorläufer der papierbildenden Pulpenströmung mit einem pH von 8,5 bis 6,5 zu bilden, eingeführt wird, und die Einführung von Kohlendioxid ansprechend auf die Messungen des pH des Vorläufers der papierbildenden Pulpenströmung reguliert wird.

2. Verfahren nach Anspruch 1, worin Kohlendioxid in einer Menge zugesetzt wird, um den pH eines Vorläufers der papierbildenden Pulpenströmung auf einen Wert von 8,5 bis 7,5 zu einzustellen.

3. Verfahren nach Anspruch 1 oder Anspruch 2, worin eine aus einem Papierherstellungsvorgang erhaltene flüssige Strömung mit dieser von Lignin befreiten Zellulosepulpe vermischt wird, um diese papierbildende Pulpe zu bilden, die mit dem gasförmigen Kohlendioxid in Kontakt zu bringen ist.

4. Verfahren nach Anspruch 3, worin diese flüssige Strömung mit dieser von Lignin befreiten Zellulosepulpe vermischt wird und in eine Ansaugseite einer Pulpenpumpe eingeführt wird, und worin gasförmiges Kohlendioxid in diese aus dieser Pulpenpumpe abgegebene papierbildende Pulpe eingeführt wird.

5. Verfahren nach einem der vorhergehenden Ansprüche, weiter dadurch gekennzeichnet, daß in die zerfaserte Pulpe gasförmiges Kohlendioxid in einer Menge eingeführt wird, um einen Vorläufer der papierbildenden Pulpenströmung mit einem pH von 7,0 bis 5,5 zu bilden.

6. Verfahren nach Anspruch 5, worin das gasförmige Kohlendioxid zu der zerfaserten Pulpe in einer Menge zugesetzt wird, um den pH dieses Vorläufers der papierbildenden Pulpenströmung auf einen Wert in dem Bereich von 6,0 bis 5,5 einzustellen.

7. Verfahren nach einem der vorhergehenden Ansprüche, weiter umfassend das Mischen der aus einem Papierherstellungsvorgang erhaltenen, flüssigen Strömung mit der Strömung von zerfaserter Pulpe, nachdem sie mit dem gasförmigen Kohlendioxid in Kontakt gebracht worden ist.

8. Verfahren nach einem der vorhergehenden Ansprüche, bei welchem keine Schwefelsäure zu der alkalischen Zellulosepulpe zugesetzt wird.

9. Vorrichtung zur Herstellung von Papier, bei welchem von Lignin befreite Zellulosepulpe in einem Refiner (28) zur Bildung von papierbildender Puple zerfasert wird, einschließend Einrichtungen (25) zum Injizieren und Dispergie-

ren von gasförmigem Kohlendioxid in eine von Lignin befreite Zellulosepulpenströmung, dadurch gekennzeichnet, daß diese Einrichtung strömungsaufwärts von diesem Refiner (28) angeordnet ist, so daß Kohlendioxid in einer Menge injiziert werden kann, um einen Vorläufer einer papierbildenden Pulpenströmung mit einem pH von 8,5 bis 6,5 zu bilden, und die Vorrichtung weiter Einrichtungen (52, 50, 56) einschließt, um den pH dieser papierbildenden Pulpenströmung abzutasten und die Einführung von Kohlendioxid ansprechend auf den abgetasteten pH einzuregulieren, so daß der gewünschte pH aufrecht erhalten wird.

**10.** Vorrichtung nach Anspruch 9, weiter einschließend Einrichtungen (60) zum Injizieren und Dispergieren von gasförmigem Kohlendioxid in eine zerfaserte Zellulosepulpenströmung in einer Menge zur Bildung eines Vorläufers von papierbildender Pulpenströmung, der einen pH von 7,0 bis 5,5 aufweist, strömungsabwärts von dem Refiner (28).

**11.** Vorrichtung nach Anspruch 10, weiter einschließend Einrichtungen (66, 64, 68) zum Abtasten des pH dieses Vorläufers von papierbildender Pulpenströmung strömungsabwärts von dem Refiner (28) und zur Regulierung der Einführung von Kohlendioxid im Ansprechen hierauf, so daß ein gewünschter pH strömungsabwärts von dem Refiner (28) aufrecht erhalten wird.

**Revendications**

**1.** Procédé de fabrication de papier à partir d'une pâte cellulosique alcaline produite par délignification d'une matière cellulosique, dans lequel la pâte cellulosique délignifiée alcaline produite subit une fibrillation dans une pile raffineuse pour la formation d'une pâte de réalisation de papier, et par introduction d'anhydride carbonique gazeux dans la pâte délignifiée, caractérisé en ce que l'anhydride carbonique gazeux est introduit en amont de l'étape de fibrillation en quantité telle qu'il forme un courant de pâte précurseur de formation de papier ayant un pH compris entre 8,5 et 6,5, et l'introduction d'anhydride carbonique est régulée en fonction de la mesure du pH du courant de pâte précurseur de formation de papier.

**2.** Procédé selon la revendication 1, dans lequel l'anhydride carbonique est ajouté en quantité telle que le pH du courant de pâte précurseur est réglé entre 8,5 et 7,5.

**3.** Procédé selon la revendication 1 ou 2, dans lequel un courant liquide obtenu à partir d'une opération de fabrication de papier est mélangé à la pâte cellulosique délignifiée pour la formation de la pâte de formation de papier qui est destinée à être mise au contact de l'anhydride carbonique gazeux.

**4.** Procédé selon la revendication 3, dans lequel le courant liquide est mélangé à la pâte cellulosique délignifiée et est introduit du côté d'aspiration d'une pompe de pâte, et de l'anhydride carbonique gazeux est introduit dans la pâte de formation du papier évacuée de la pompe de pâte.

**5.** Procédé selon l'une quelconque des revendications précédentes, caractérisé en outre en ce que de l'anhydride carbonique gazeux est introduit dans la pâte fibrillée en quantité telle qu'un courant de pâte précurseur de formation de papier est formé avec un pH compris entre 7,0 et 5,5.

**6.** Procédé selon la revendication 5, dans lequel l'anhydride carbonique gazeux est ajouté à la pâte fibrillée en quantité telle que le pH du courant de pâte précurseur est réglé à une valeur comprise entre 6,0 et 5,5.

**7.** Procédé selon l'une quelconque des revendications précédentes, comprenant en outre le mélange d'un courant liquide obtenu à partir de l'opération de fabrication de papier au courant de pâte défibrillé après sa mise en contact avec l'anhydride carbonique gazeux.

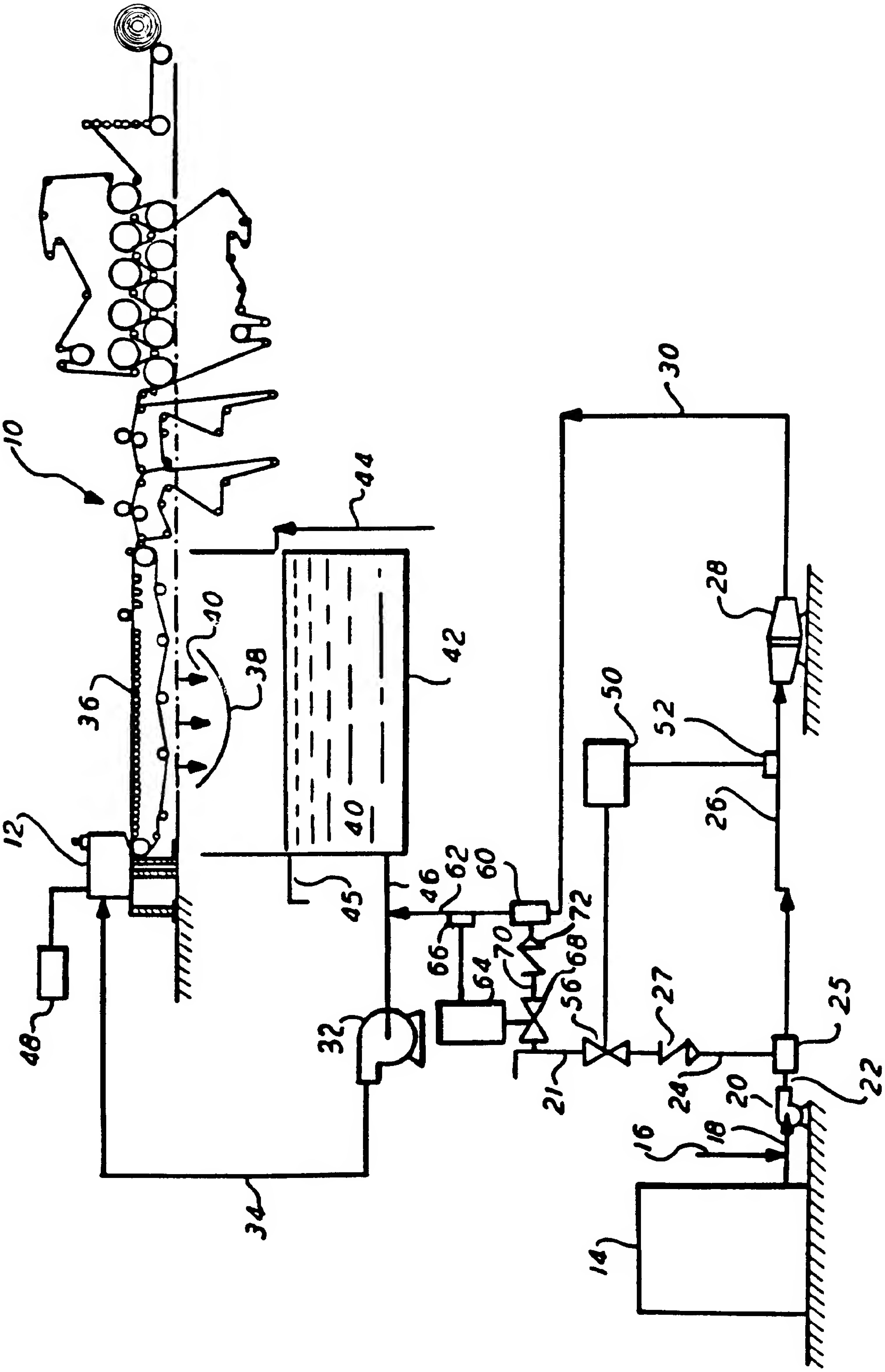
**8.** Procédé selon l'une quelconque des revendications précédentes, dans lequel aucune quantité d'acide sulfurique n'est ajoutée à la pâte cellulosique alcaline.

**9.** Appareil de fabrication de papier, dans lequel une pâte cellulosique délignifiée subit une fibrillation dans une pile raffineuse (28) pour la formation d'une pâte de fabrication de papier, comportant un dispositif (25) d'injection et de dispersion d'anhydride carbonique gazeux dans un courant de pâte cellulosique délignifiée, caractérisé en ce que le dispositif est placé en amont de la pile raffineuse (28) afin qu'il permette l'injection d'anhydride carbonique en quantité telle qu'un courant de pâte précurseur de formation de papier est formé avec un pH compris entre 8,5 et 6,5, et l'appareil comporte en outre un dispositif (52, 50, 56) de détection du pH du courant de pâte de formation de papier et de régulation de l'intro-

duction d'anhydride carbonique en fonction du pH détecté afin que le pH voulu soit maintenu.

**10.** Appareil selon la revendication 9, comprenant en outre un dispositif (60) d'injection et de dispersion d'anhydride carbonique gazeux dans un courant de pâte cellulosique fibrillé en quantité telle qu'un courant de pâte précurseur de formation de papier est formé avec un pH compris entre 7,0 et 5,5 en aval de la pile raffineuse (28).

**11.** Appareil selon la revendication 10, comprenant en outre un dispositif (66, 64, 68) destiné à détecter le pH du courant de pâte précurseur de formation de papier en aval de la pile raffineuse (28) et de régulation de l'introduction d'anhydride carbonique en fonction du maintien du pH voulu en aval de la pile raffineuse (28).


10
12
14
16
18
20
21
22
24
25
26
27
28
30
32
34
36
38
40
42
44
45
46
48
50
52
56
60
62
64
66
68
70
72